



Observations from Root Cause Analyses

November 2nd, 2011

David Nicholls
OUSD (AT&L) / PARCA
David.Nicholls@osd.mil



Root Cause Analysis Functions

▶ Statutory duties defined in the Weapons Systems Acquisition Reform Act of 2009 (WSARA 09):

- Conduct root cause analyses for major defense acquisition programs:
 - As part of the Nunn-McCurdy breach certification process.

▪ When requested by designated officials, **WSARA 09 states that the Secretary of Defense shall**

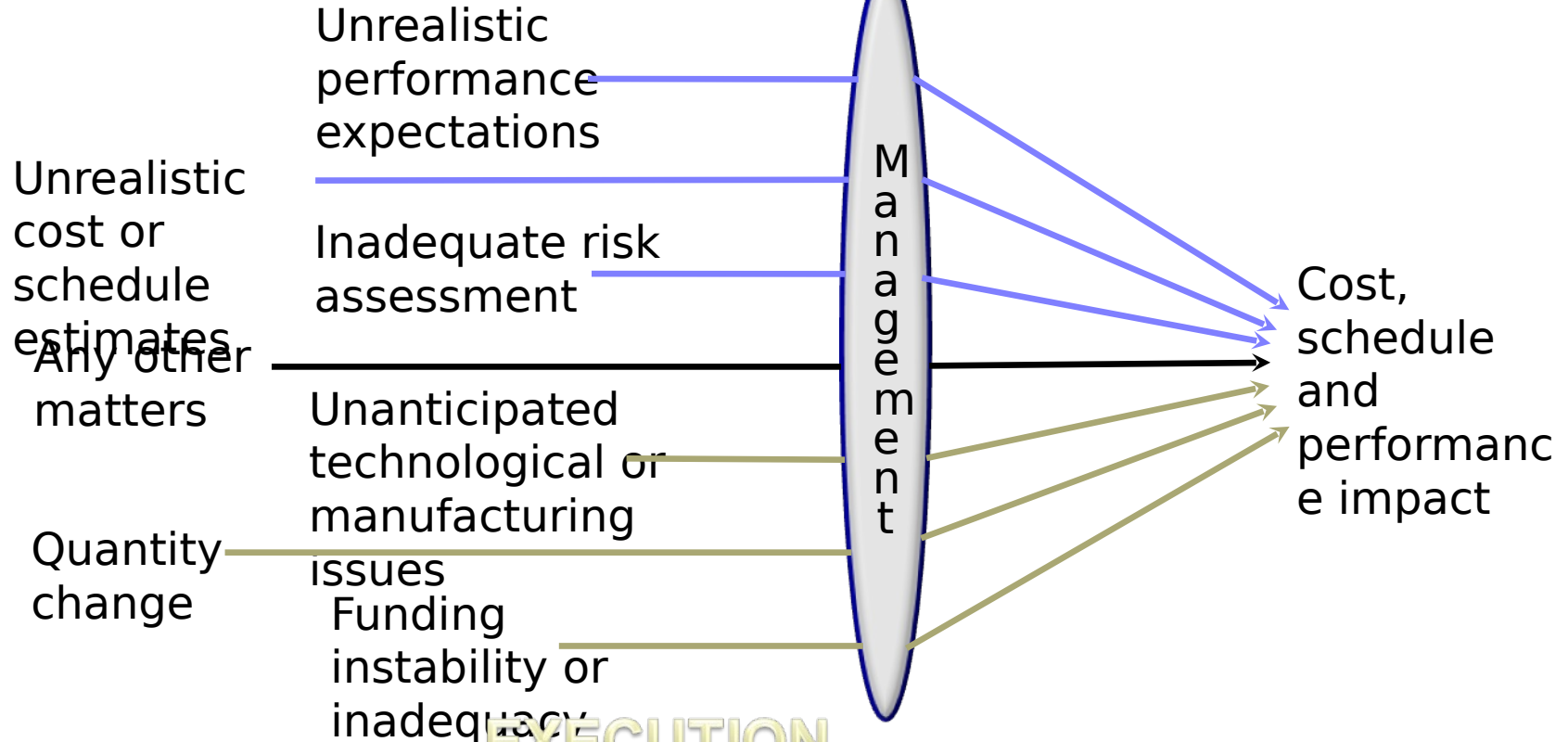
- Issue policies, procedures, and guidance governing the conduct of root cause analyses **(1) Determine the root cause or causes of the critical cost growth.**

▶ Identified lessons learned for the benefit of the acquisition community **(2) If program is not terminated, restructure the program in a manner that addresses the root cause or causes of the critical cost growth**



Analytical Framework

INCEPTION



Problems will occur: why they occur and our response to them are crucial subjects for root cause analysis.



Preliminary Trends

	Programs											
Inception Issues	A	B	C	D	E	F	G	H	I	J	K	L
Unrealistic performance expectations		X										
Unrealistic cost or schedule estimates			X	X					X	X	X	
Inadequate risk assessments												
Other									X			
Execution Issues	A	B	C	D	E	F	G	H	I	J	K	L
Unanticipated technological or manufacturing issues	X											
Quantity change			X	X				X				
Funding instability or inadequacy												
Poor management performance			X			X	X		X		X	X

Root causes must be relevant as well as true.



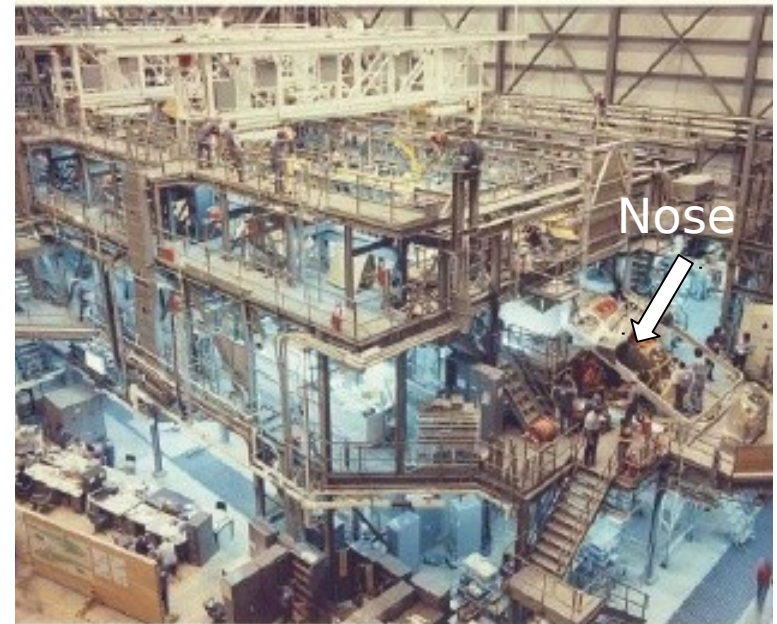
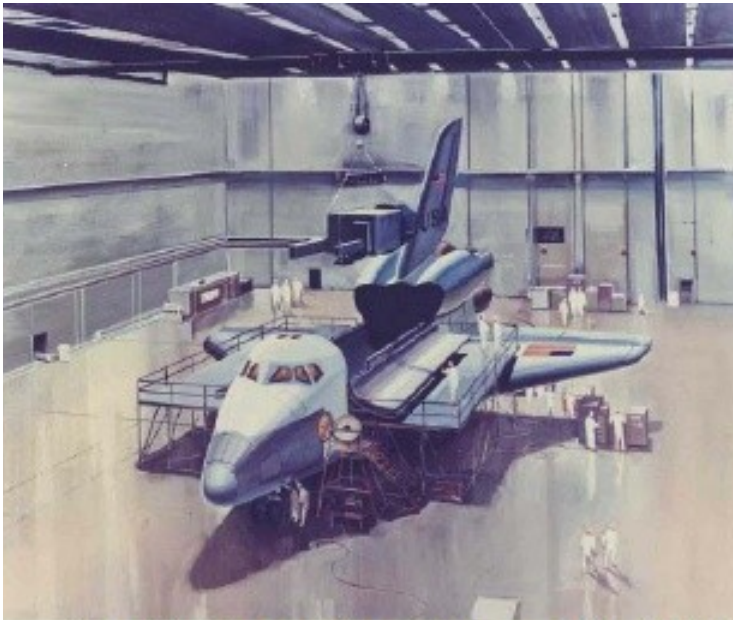
Overview

- ▶ **Unrealistic Estimates**
- ▶ **Changes in Quantity**
- ▶ **Management Performance**



Why are Estimates Unrealistic?

- ▶ Unrealistic estimates are caused by the invalidity of major cost estimating assumptions NOT methodological errors.



- ▶ PARCA's criterion for an estimate to be unrealistic is that the assumption was uncertain at the time of the estimate.



Estimating Assumptions Flow from Framing Assumptions (F-35 Example)

Framing Assumptions

Design is mature
(Prototype design is close to Production-Ready)

Consequences

Production and development can be concurrent

Weight (critical for vertical lift) is known

Design can now be refined for affordability

Estimating Assumptions

Schedule will be more compact than historical experience

Weight will not grow as usual for tactical aircraft

Affordability initiatives will reduce production cost

Responsible Communities:

Requirements, Technical, & Program Management
Cost Estimators

Cost and Schedule Estimates



Illustrative Sources for Framing Assumptions

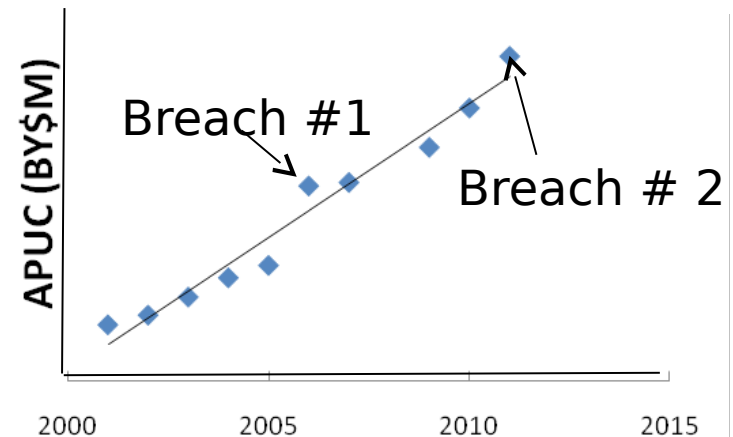
- ▶ **Pre-MS B activities:** The design is very similar to the ACTD.
- ▶ **Technical base:** Modular construction will result in significant cost savings.
- ▶ **Program dependencies:** Other programs will facilitate solution of size, weight, and power issues.
- ▶ **Organizational relationships and incentives:** Arbitrating multi-Service requirements will be straightforward.
- ▶ **Threat or operational needs:** The need for precision strike of urban targets will not decline.
- ▶ **Policy or policy implementation:** The conditions are met for a firm, fixed price contract.
- ▶ **Industrial base/market:** The satellite bus will have substantial commercial market for the duration of government purchases.

Insight required to identify what really matters.



Role in N-M Breaches

- ▶ When an invalid framing assumption is embraced:
 - Evidence of problems will accumulate.
 - Cost and schedule estimates will need to be changed.
- ▶ But, the amount of growth will depend on:
 - How promptly management recognizes the issues.
 - How effectively management responds.
- ▶ Further cost growth if the full implications of the invalid framing assumption are not addressed.





Framing Assumption Characteristics

- ▶ A minimal set of assertions which establishes the conditions for program to meet cost, schedule, and performance goals:
- ▶ If invalid, the paradigm changes.
- ▶ Will generally have multiple implications.
- ▶ Must be able to assess their validity:
 - To assess initial program viability.
 - As a context for continued program assessments.

1. What are YOUR program's framing assumptions?
2. How do you assess, and reassess, their validity?

3. How do they affect your management?



Overview

- ▶ **Unrealistic Estimates**
- ▶ **Changes in Quantity**
- ▶ **Management Performance**



Quantity Changes

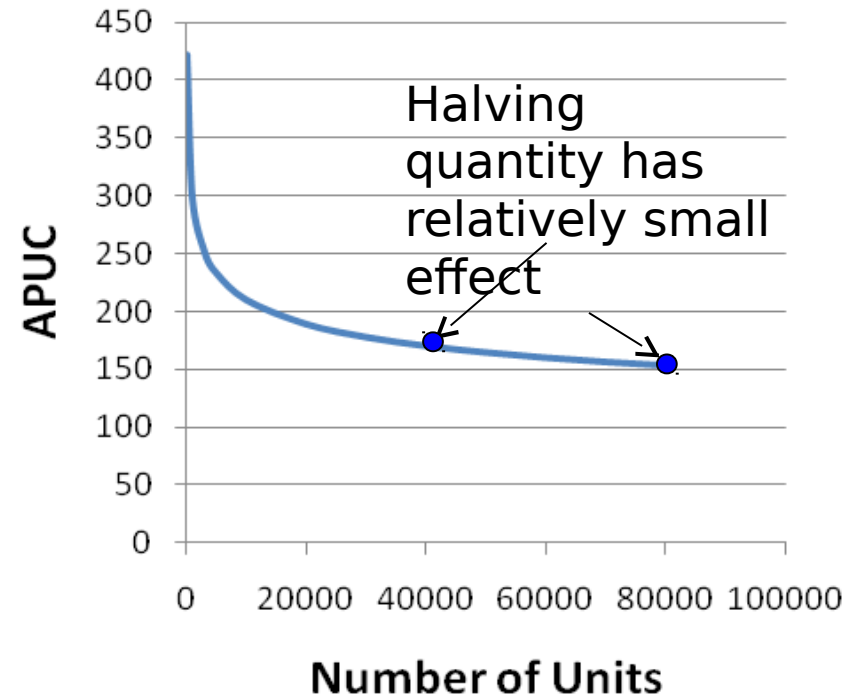
- ▶ To consider a quantity change to be a root cause, PARCA has defined two conditions:
 - The reason for the change was outside the control of the acquisition community:
 - Doctrinal or threat change **but NOT** Escalating unit costs
 - “Pure” fiscal constraints Schedule slips
 - Other cost growth would not have caused a breach without the quantity change.
- ▶ To date, PARCA has observed that quantity changes were due to factors within the control of the acquisition community in about half of the cases

Quantities are changed for a reason.



The Impact of Changing Quantity Depends on Other Decisions

- ▶ Quantity change in isolation mainly impacts Program Acquisition Unit Cost (PAUC):
 - Development costs amortized over fewer units.
 - Modest learning effects on Average Production Unit Cost (APUC)
- ▶ Two separate decisions often affect unit costs as much as the quantity change itself:
 - Reduce annual buy or curtail program.
 - The mix of systems can change (or confuse) unit costs.





Overview

- ▶ **Unrealistic Estimates**
- ▶ **Changes in Quantity**
- ▶ **Management Performance**



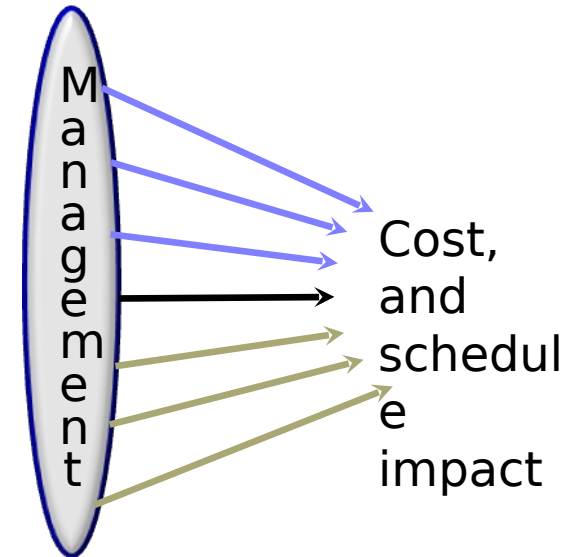
Poor Management Performance

➤ Management performance is the lens through which all program issues are addressed:

- Contractor
- Program Office
- PEO

➤ PARCDA has found issues in three broad areas:

- Systems engineering.
- Incentive strategy.
- Situational awareness and organizational response.





Systems Engineering

► General observations:

- High potential as a root cause because systems engineering is critical for complex systems.
- Process definition required but can dominate substance.
“Strong in process but weak in integration” – PMO assessment
- Recognizing poor systems engineering early a challenge.
- “Systems Engineering” too broad for actionable root causes.

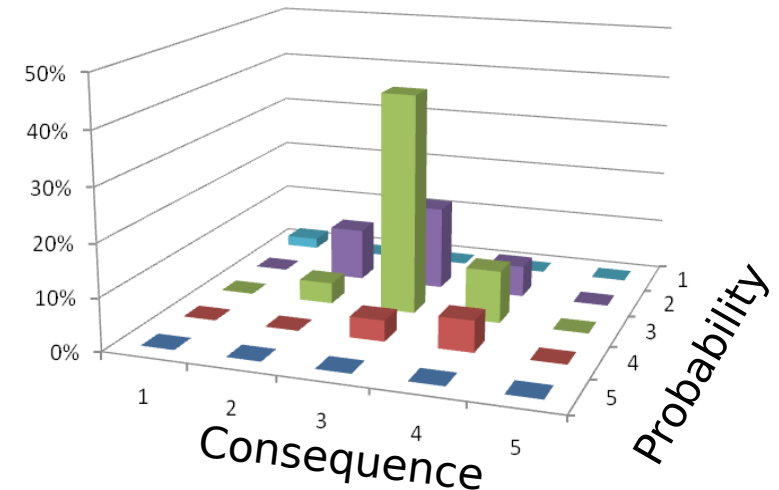
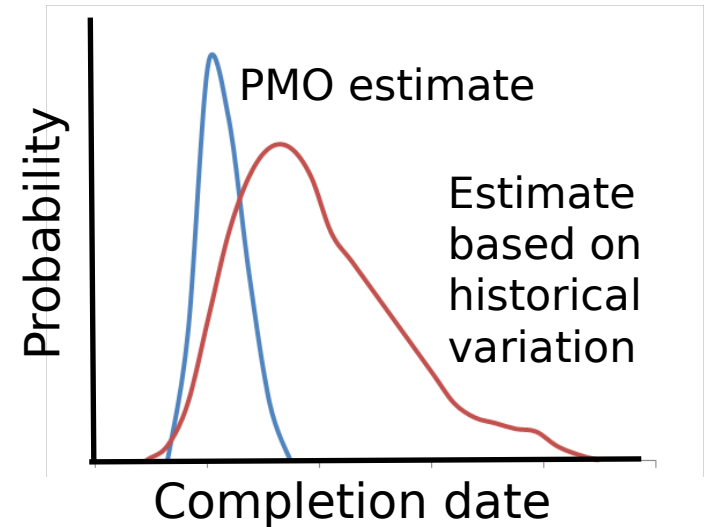
► Areas where problems have been observed include:

- Requirements management.
- Interface and environment management.
- Holistic performance attributes e.g. reliability, weight.
- Risk assessment.



Risk Assessment in Systems Engineering

- ▶ Relatively narrow risk distributions:
 - Modest estimates of consequences.
 - Correlations and other task dependencies are difficult to estimate.
- ▶ Can obscure rather than illuminate:
 - Monte Carlo modeling can deemphasize impact of larger, more distant “bets”
 - 1-5 consequence scale not transparent as to scale of impact.





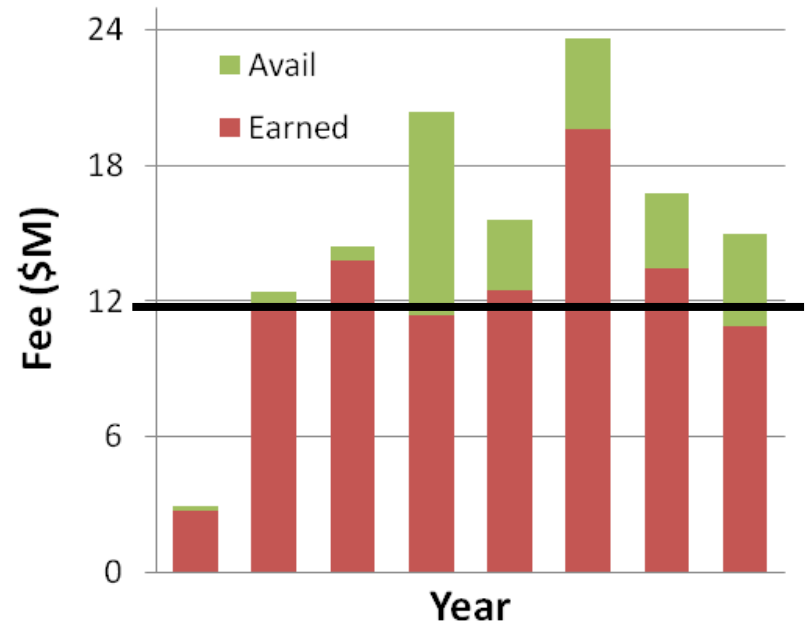
Effective Incentive Strategy

▶ Incentive evaluation:

- Aligned with program goals and challenges.
- Demanding yet achievable.
- Sufficient to motivate.
- No perverse effects.
- Correct signal sent and received.

▶ Incentive strategy:

- Conditions for strategy satisfied?
- Consistent with corporate goals and position.



Government goals but contractor's perspective.



Situational Awareness - Contract Performance \neq Program Performance

- ▶ Several cases where program content evolved:
 - Work not understood.
 - “Unfunded” requirement.
 - Spiral development (almost by definition).
- ▶ Consequences require management:
 - Contract performance differs from program performance.
 - Discipline in program content.
 - Budgetary pressure.



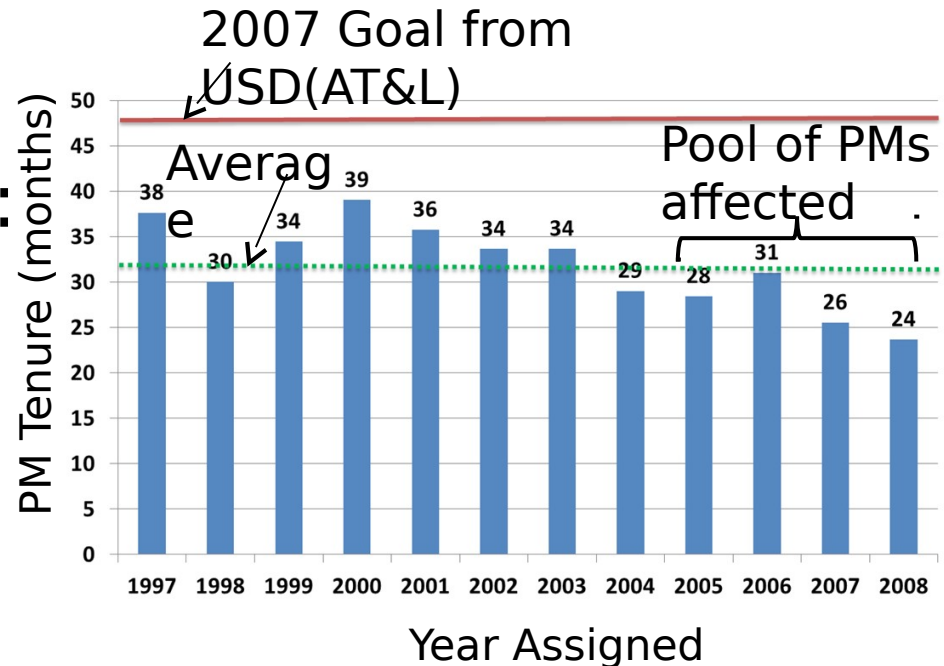
Organizational Response

► Implementation of direction not assured:

- PM tenure
- ADMs

► Organizational performance issues appear to persist:

- Problems identified in first breach documentation:
 - “Management and systems engineering processes were not in place”
 - Contractor “did not effectively tap ... expertise resident within team.”
 - “Concurrent activities increased program execution complexity.”
- PARCA finds same problems at second breach.





Closing Comments

- ▶ PARCA's role in N-M process is to help identify program root causes so that we don't have more cost growth.
- ▶ PARCA's observations:
 - Primary inception issue stems from invalid framing assumptions which lead to bad estimates.
 - Primary execution issue is poor management performance:
 - Systems engineering.
 - Contractual incentives.
 - Situational awareness and organizational response.
 - Exogenous quantity changes are also significant factor:
 - Not as often as claimed.
 - How a quantity change is implemented is also important.